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Water Quality Assessed In Upper Brazos Basin Watershed

The Water Resources Center and the Environmental Science Laboratory recently assisted in Phase 1 of the study summarized below. Other organizations directly involved were the Texas Water Commission, the High Plains Underground Water Conservation District No. 1, the District Conservationist of the USDA Soil Conservation Service, the U.S. Geological Survey and the Texas A&M Agricultural Extension Center, with the Brazos River Authority coordinating the project.

Background

Senate Bill 818 requires the Texas Water Commission, primarily through the River Authorities of the State of Texas, to identify and assess the sources of contamination to groundwater and surface water in river basin drainage areas of the state. With non-point source pollution being emphasized as a possible large contributor to both groundwater and surface water contamination, a study is being conducted to determine the source of these pollutants. Stormwater runoff over the High Plains region is the greatest water source for playa basins. Since playas are located in the lowest elevation of closed drainage systems and are typical of the rural and urban landscapes of this area, they are important indicators of non-point source contamination. The quality of these playa lakes affects the groundwater quality because a major portion of the water in many playas infiltrates the lake basin soils and recharges the underlying groundwater.

There has never been a broad survey of the surface water quality of either the Llano Estacado as a whole, or even that part of the region within the Brazos River drainage. In the studies encountered to date there were differing requirements for water quality information, resulting in a lack of uniformity in the data reported among them.

Methods

The assessment of potential contamination in the Brazos basin through playas is to be accomplished in two phases. Phase I was to make determinations as to whether the principal non-point source pollutants are present in the water as a result of runoff from the agricultural lands. Basins with obvious potential sources of contamination such as feed lots, oilfield activities, municipal wastewater treatment, and landfills were not included.

Results

Waters from a total of 99 basins were analyzed in Phase I, resulting in the following conclusions:

- The quality of the water accumulating in the vast majority of the basins is good. With the exception of the elevated dissolved solids (and associated parameters) in approximately ten percent of the basins, there are very few anomalous values among the standard water quality parameters measured. There is an investigation to determine if the basins with high TDS are unreported saline, pluvial basins similar to those already known in the region.

- There are detectable levels of residues of either triazine herbicides or aldicarb insecticides in virtually every basin studied. While the levels

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Brazos Basin

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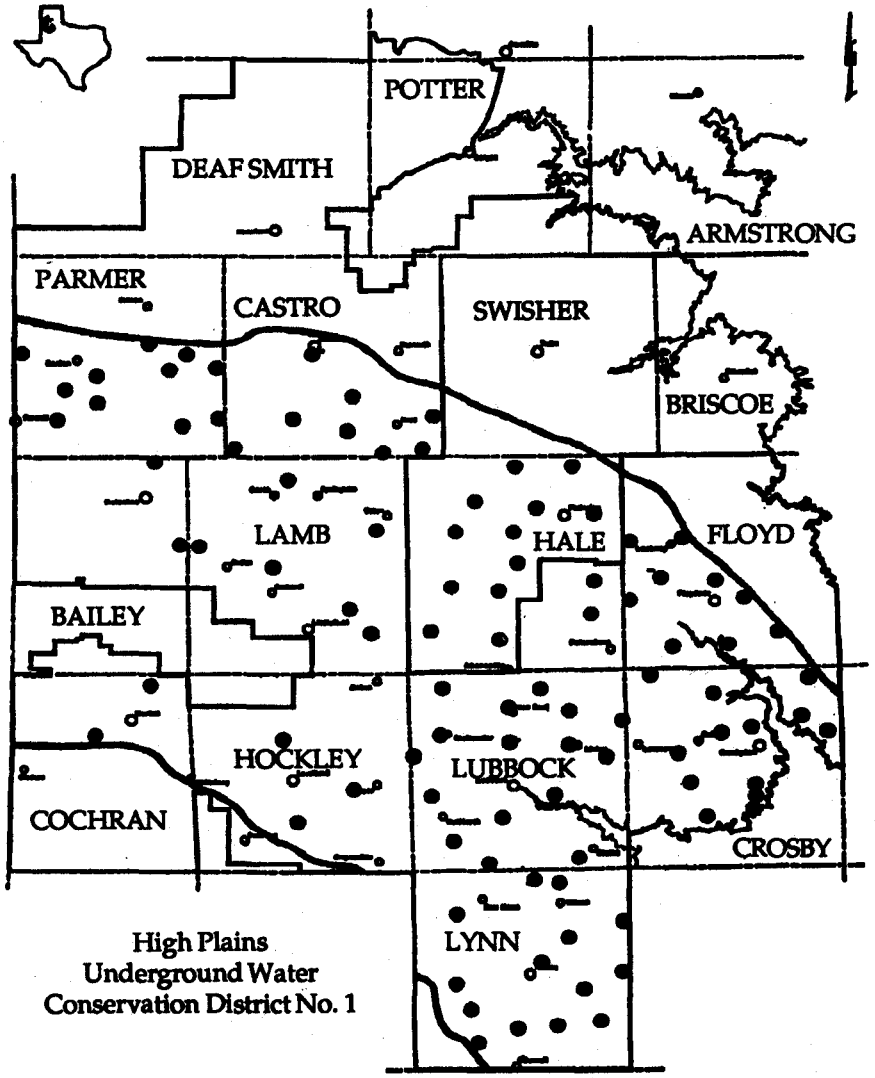

Approximate locations of sampled playa basins.

reported do not appear to be either sufficiently high, or in a location to present a significant risk to human or environmental health, they are too high and too prevalent to be considered inconsequential.

Recommendations

Among eleven approaches considered, the following three were given highest priority by the present investigators.

1. Initiate studies on the impact of contaminants on the resident biota of the playa basins for the purpose of developing the biota as index species in bioassays.

2. Begin acquiring necessary resources and assembling the expertise to establish a GIS program for the long-term management of water quality data.

3. Determine the potential for pesticides to reach groundwater. This would entail testing soil cores, resampling basin water, testing water from wells both above and below gradient. The success of this undertaking would depend heavily on gaining access to a sufficient number of wells near enough to target basins to provide conclusive information.

Phase 2

The first project in Phase 2 will be the reanalysis of sediments and water from several playa basins where pesticide residues have been encountered. To evaluate variation in distribution of residues, the sediments analyzed will be taken from three locations in each basin. At each location an intact core sample will be extracted. Discreet segments of each core will be tested to estimate the depth to which residues may penetrate.

Water from a select number of irrigation wells surrounding each of the respective basins will also be analyzed. All samples will be screened for pesticide residues by the ELISA (Enzyme-Linked Immunosorbent Assay) technology. Positive samples will be confirmed by GC/MS (Gas Chromatography /Mass Spectrometry). Subsequent projects will first depend on the outcome of the first project, then the season and personnel available to conduct field work.

Update - Water Balance of Cotton Products Systems

Dr. Daniel R. Krieg, Department of Agronomy, Horticulture and Entomology, and Dr. Robert Lascano, Texas Agricultural Experiment Station are the principal investigators for this project.

Lack of an adequate water supply throughout the life cycle is the single greatest environmental limitation to attainment of genetic yield potential of most crop plants. This statement is especially true on the Southern High Plains of Texas for cotton, the major cash crop of the state. There are over 3 million acres of cotton produced annually within a 60 mile radius of Lubbock. Over 60% of the acreage is totally dependent upon rainfall while the other 40% has access to supplemental irrigation. The summer precipitation which averages 10-13 inches from May through September is of two types:

- low volume events where over 50% of the total events average less than 0.25 inches/day
- high intensity thunderstorm type events when the precipitation rate greatly exceeds the soil infiltration rate.

Both of these types of precipitation events result in considerable waste of water. The first type results in a very high percentage of the rainfall being lost to free soil evaporation. The second type results in considerable runoff. Two approaches have been developed to minimize wasted water due to the conditions described. One is a ground cover of dead wheat which increases the reflected radiation (reducing the energy available at the soil surface to evaporate water) and reduces the wind speed at the soil surface (increasing the depth of the saturated air zone.) The second is minidikes in the furrows to trap water in place when precipitation exceeds infiltration of the soil.

The basic objective of this project is to determine the total water balance (on an annual basis) for various management systems designed to minimize waste of water (both precipitation and irrigation). The experiment is being conducted on two soil textures (clay loam and loamy sand) which provide contrasts in infiltration rates, water holding capacity and natural reflected radiation (albedo.)

Within each textural class, a wheat cover versus bare soil has been established. The experimental design within each soil type will be two ground covers (base versus terminated wheat) and two dike systems (diked versus undiked) for a 2x2 factorial. Two water supplies within each treatment (natural rainfall versus supplemental irrigation) have also been established.

A complete water balance for each treatment will be developed which includes measurements and estimates of:

1. Total water supply - rainfall plus irrigation
2. Runoff
3. Free soil evaporation
4. Crop water use (both wheat and cotton)

The basic questions being addressed are:

1. What does it cost (in terms of water) to grow the wheat crop to the stage of growth where it can be beneficial when terminated?
2. Does the dead wheat plant act as a wick and continue to transport water from the soil into the atmosphere?
3. Does the wheat ground cover reduce bare soil evaporation and what are the water savings from both rainfall and irrigation?
4. Does the wheat cover break up the raindrops and increase infiltration?
5. Do furrow-dikes minimize runoff and what is the gain in total water supply to the crop?
6. Does the additional water supply (if there is any) to the cotton crop result in yield gain?

The plots have been established and the researchers are waiting for the weather to warm sufficiently for planting (late April, early May).

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Classification of Playa Basins Imperative

Dr. Tony Mollhagen, Department of Civil Engineering, reports on the classification of playa basins.

There are several current imperatives for a functional classification of individual playa basins: their potential for delineation as jurisdictional wetlands, production and preservation of game, and salvage of surface water. Previous efforts to classify local basins, which largely focused on their potential as water resources, use as wildlife habitat, and geologic origin, commonly do not relate observations to specific basins. Furthermore, the vast majority of other kinds of research on playas in the region either report averaged values from more than one basin or do not identify the individual basins from which data were taken. These practices eliminate any documentation of changes in individual basins over time, deny background information to researchers in other disciplines, as well as promote the erroneous notion that all playa basins are essentially the same.

Where possible, Ms. Dianne Hall (Ph.D. student in Biology) with the help of Ms. Kavitha Casula and Mr. Steve Martin (M.S. students in Civil Engineering) have been screening playa literature and field notes for references to specific basins. Basins are being located on quadrangle maps and catalogued. All subsequent information on a basin is cross-referenced through the catalog number. The literature retrieved to date has originated in many disciplines, including anthropology, geology, biology, ecology, range and wildlife management, public health, parasitology, soil science, agronomy, water resources, and hydrology. In addition to location, the catalog will provide the means to quickly assemble all available information specific to each basin. The next phase of the work will be to take existing EPA, SCS, and USFWS assessment protocols and test them against basins with known biotic or water quality characteristics.

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